



Case report

Establishment of the medico-legal cause of death in two atypical cases of gas embolism in hospital: Importance of the scene

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ABSTRACT

Two cases of lethal gas embolism occurring in a hospital setting are presented. These did not differ with regards to the medical cause of death (MCOD), but did so with regard to the medico-legal cause of death (MLCOD). In the first case, the immediate recognition of a suspicious death and subsequent conservation of the scene led to a certain MLCOD (autolysis). In the second case, the death was initially treated as of natural cause. The subsequent disruption of the scene of death led to loss of evidence essential to establish the MLCOD, that was concluded to be undetermined. These cases illustrate the importance of medico-legal treatment of scenes of death to arrive at the MLCOD, and that the hospital setting is no exception especially as in view of potential medical liability.

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1. Introduction

Forensic pathology is a branch of medicine that applies the principles and knowledge of the medical sciences to problems in the field of law¹. The role of the forensic pathologist is to be a real technical informer who plays the role of the judicial system's assistant in the interface of medical science with law and public policy. The daily task of the forensic pathologist involves investigations and objective evaluations of injuries, reconstructions of criminal acts, and construction of causal chains leading to injury or death.²

One of the main tasks of the forensic pathologist is to determine the Medical Cause Of Death (MCOD) and the Medico-Legal Cause Of Death (MLCOD), which is also referred to as the manner of death.^{3–5} In many countries, including France, the MLCOD may be defined as one of five possibilities: natural, accidental, autolysis, homicide, or undetermined.⁶ Contrary to the MCODE, the MLCOD cannot be determined by any other practitioner than a forensic pathologist.^{7,8}

In the French medical system, any death leads to a death certificate. It is filled-out by a physician who can be a (family) general practitioner or the hospital physician on duty, if the death occurs in a medical setting. When the death first appears as not suspicious (i.e.

“natural”) the physician fills out the certificate, indicating the MCODE. For various reasons, this may be erroneous for deaths occurring in hospitals⁹ owing to a lack of familiarity with the deceased in cases of sudden, unexpected death especially in the emergency department.¹⁰ In such cases, the MLCOD is not investigated. In the case of suspicious death, the physician indicates this on the certificate by ticking the appropriate box and this sets off a procedure where the police call in a forensic pathologist. The latter will then try to determine the MCODE and MLCOD by specific means such as thanatology examination. At this stage the MLCOD can be unknown and the body is under judicial sequestration. In such a system the first physician who certifies death has a strategic position for the rest of the procedure. However, if the judicial authorities are informed and consider the scene as suspect whatever the opinion of the physician, they are entitled to keep the body under judicial treatment for the MLCOD to be determined by a forensic pathologist.

In forensic medicine omissions and errors are often irreparable. If an examination is missing, incomplete or inadequate, or if the MLCOD is not well determined, the truth may not be arrived at. This is particularly true in medical settings where deaths are too often considered as natural. Furthermore, as the police are very rarely involved and the medical personnel not used to ask for judicial assistance, when there is a suspicious death it may be treated in the same manner as a natural death.

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Fig. 1. Case 1. Scene of death: the body was found on a hospital bed.

As an illustration, herein are presented two similar cases of lethal gas embolism occurring in a hospital setting for which the MLCOD differed due to the treatment of the scene of death even though the MCOD was known.

2. Case report

2.1. Case histories

2.1.1. Case 1

A 76-year-old man with a history of COPD was hospitalized for a pneumopathy with hemoptysis. After 72 h of hospitalization, he was found dead in his bed 3 h after having received treatment (last contact with staff). He had recently learnt that a check-up was planned to investigate a suspect mass at the pulmonary level discovered by radiological examination. The nurses who discovered the deceased noticed that the tubule connecting to the portable respirator - the same as he used at home - with a flow rate of



Fig. 3. Case 1. Scene of death: the portable respirator was connected to the antebachial drip by the respirator tubule.

oxygen at 3 l/min was linked to his antebachial drip (Fig. 1, Fig. 2, Fig. 3). A suspicious death was indicated on the death certificate by the physician on duty in the ward. Owing to this, the scene of death was preserved for subsequent forensic investigations.

2.1.2. Case 2

A 77-year-old man was found dead in his post-operative hospital bed following exploratory visceral surgery about 1 h after having been placed on oxygen therapy at 2 l/min after a minor dyspneic episode (last contact with staff). The medical team noticed that the tubule connecting to the wall oxygen supply socket was linked to his antebachial drip. A suspicious death was not indicated on the death certificate; the physician on duty gave the MCOD as gas embolism. The deceased was then mobilized and the oxygen tubules disconnected from the deceased and the wall socket. However, the police were contacted the following morning by a hospital administrator, and the forensic investigation followed.

2.2. External exam

The two corpses presented clinical similarities summarized in Tables 1 and 2.

2.3. Autopsy results

In the two cases, the MCOD was associated with an acute pulmonary heart with terminal arrhythmia. To be more precise, both deaths were due to a high delivery of oxygen into the organism. In



Fig. 2. Case 1. Scene of death: detail of the portable respirator.

Table 1

Post-mortem external semiology for both corpses.

Areas	Findings
Head/Face	Laying petechiae, congestion, cyanosis, bruise-like lesions, swelling, froth and blood around mouth and nostrils, protrusion of the tongue, swelling of the eyelids
Neck	Diffuse petechiae
Trunk	Phlyctenulae filled by clear gas/epidermis detachment
Upper/lower limbs	Intense cyanosis of the extremities; phlyctenulae filled by clear gas
Back	Intense purple petechiae on declive zones; large bruise-like lesions

Table 2
Post-mortem internal semiology for both corpses.

Organs findings	Findings
Cerebral	Brain softening
Arterial system	Petechiae hemorrhages of white matter
	Peri-coronaries petechiae
	Foaming blood
Venous system	Peri-coronaries petechiae
	Foaming blood
Lungs	Pulmonary emphysema; not or poor congestion
Heart	Foaming blood in right atrium and ventricles
	Petechial epicardium
	Absence of bubbles in right ventricle
Liver and gall bladder	Dehydration aspect of the Glisson's capsule
	Acute dilatation of gall bladder
Other viscera	Drying artefact
	Dilatation of hollow organs
Subcutaneous tissue	Drying aspect

both cases, several liters/minute were injected into the body; air embolism is considered lethal from 3 to 5 ml/kg.⁸ If the volume of air is important, there is an immediate blocking of the right ventricular blood flow, with irreversible increased parietal blood pressure. The formation of an acute pulmonary heart with circulatory collapse follows, and then death.^{5,11}

Histopathology and toxicology were performed did not bring other elements to the MCODE and confirmed the macroscopic observations of the autopsy.

3. Comments

For both cases the MCODE were the same and both were obvious, yet the MLCODE were not.

3.1. Case 1: conclusions were in favor of an autolysis

Here the treatment of the scene by scientific police helped to confirm autolysis as the MLCODE. Fingerprints of the deceased were found on the tubules and on various parts of the respirator, and DNA analysis found cells belonging to the deceased. Thus, the deceased was likely to be the last person to have touched the tubule. His medical record was seized to determine medico-surgical and psychological anamnesis. At admission, the deceased was given anxiolytic agents. During his stay he had told a nurse he was afraid of losing his autonomy and independence, and psychological help was called for.

In view of these points, autolysis was retained as the MLCODE.

3.2. Case 2: conclusions were in favor of an undetermined cause

Here the lack of treatment of the scene by forensic services led to an undetermined MLCODE owing to a huge loss of evidence. Other causes could have been concluded, but there were no medico-legal elements in favor of natural death, homicide or autolysis. However, accidental death could have been one of them as incorrect manipulation of apparatus by medical staff is not rare and must be investigated. Review of the medical file found that numerous medical acts had been performed by under-qualified staff (i.e. assistant nurses or medical students) and thus an error in the manipulation of the apparatus may have occurred, but there was insufficient evidence for such a conclusion to be made.

4. Discussion

Mazzolo considers that the alternative between a suicide, a homicide or an accident is crucial and often narrow.¹² The two

cases presented, that were similar in terms of MCODE, underline this: whereas all the listed elements converged to an autolysis in case 1, the MLCODE was considered as undetermined in case 2.

For both cases, the MLCODE was arrived at by considering information not derived from the autopsy. In case 2, the lack of biological samples (fingerprints and DNA) owing to disruption and pollution of the scene prevented the forensic pathologist from concluding a certain MLCODE. Such a situation is a reminder that death of undetermined origin is usually a default conclusion once all others have been considered but not retained; yet it may not be rare. For instance, at the Department of Forensic Science of the Bordeaux teaching hospitals death of undetermined origin was concluded for 7% of the 2758 deaths investigated between 2004 and 2008 (unpublished data).

Atypical injuries or scenes of death require careful forensic investigation,¹² and should always be considered as highly suspect in a medical setting. There can be no doubt that at discovery of the cases reported here would be easily recognized as suspicious. However, forensic and police investigations are often dependent on the initial assessment made by the person who first discovered the dead body or declared the death. In medical settings, the physician will focus on the MCODE without anticipating the MLCODE, the distinction of which is poorly understood by those not having forensic training.¹³ Practitioners in hospitals are not used to work with judicial authorities, as death from natural causes is part of their job (as illustrated by case 2 where it was a hospital administrator and not the physician who declared the death who instigated the forensic investigation). They may not anticipate either the potential penal procedure or possible medical liability and consequently don't think about "freezing" the scene of death; considering, by definition, the hospital setting as not suspicious. But accidents due to incorrect manipulation of equipment by the medical staff can occur and must be looked for, especially as this issue can be a cause of medical liability. In the cases presented there may have been inadequate surveillance, lack of precautionary principle in terms of medical devices (adaptability of tubes), manipulation errors, or miss-appreciation of the patient's suicidal risk. In case 2 it was found that numerous acts were performed by under-qualified staff (nursing auxiliary, trainees, students) and thus accidental death may have been the MLCODE, but there was insufficient evidence to conclude.

Education of medical personnel and closer collaboration between forensic and other hospital departments could help in identifying cases of suspicious death and preservation of the scene.¹⁴ This is particularly meaningful as both the deterioration or destruction of evidence and the modification of a scene of criminal death before any judicial investigations are offences (articles 434–4 and 55 of the French Penal Code). The application of rigorous medico-legal procedure may consequently avoid or decrease the degree of uncertainty in subsequent forensic investigation.¹⁵ Therefore, management of the scene of death should be done in a scientific manner and in a way that would be understood by whoever is potentially in contact with death,¹⁶ especially medical staff.

5. Conclusion

The cases highlight that the medico-legal treatment of the scene of a suspicious death is indispensable for the establishment of the MLCODE. In addition to the nature of death, the hospital setting adds the dimension of medical liability.

Conflict of interest

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